Amendment to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) An apparatus for measuring a spectral distribution of a narrow-band laser beam generated by a line-narrowed excimer laser or a molecular fluorine laser system, comprising:

an interferometric device disposed along an optical path of an output beam of the laser system such that the beam traverses the interferometric device on a first pass;

a retro-reflector disposed after the interferometric device along said optical path for retro-reflecting the beam back through the interferometric device on a second pass; and

a detector for ~~detecting~~ measuring an intensity of the beam after the second pass through the interferometric device, and

wherein the interferometric device is tunable to any of a plurality of free spectral ranges, such that the beam traversing the interferometric device is tuned over one of the plurality of free spectral ranges, and

wherein spectral information is determined ~~when the wavelength of the laser system is tuned and the detector measures~~ by using the detector to measure the intensity of the beam at each of [[a]] the plurality of free spectral ranges ~~wavelengths~~.

2. (Original) The apparatus of Claim 1, wherein the detector includes a photodiode.

3. (Original) The apparatus of Claim 1, further comprising a light guidance cable, wherein the beam is directed towards the interferometric device through the light guidance cable.

4. (Original) The apparatus of Claim 3, wherein the light guidance cable includes a fiber optic.

5. (Original) The apparatus of Claim 3, further comprising a beam expander for expanding the beam after traversing the light guidance cable and before being incident upon the interferometric device.

6. (Original) The apparatus of Claim 3, further comprising a focusing lens, wherein the output beam is focused onto an input face of the light guidance cable by the lens.

7. (Original) The apparatus of Claim 3, wherein the beam makes a third interferometric pass prior to being incident upon the detector.

8. (Original) The apparatus of Claim 7, further comprising a second retro-reflector disposed after the first retro-reflector along the optical path of the beam, and after the beam has traversed the interferometric device on the second pass, the second retro-reflector for retro-reflecting the beam back through the interferometric device on the third pass.

9. (Original) The apparatus of Claim 1, wherein the beam makes a third interferometric pass prior to being incident upon the detector.

10. (Original) The apparatus of Claim 9, further comprising a second retro-reflector disposed after the first retro-reflector along the optical path of the beam, and after the beam has traversed the interferometric device on the second pass, the second retro-reflector for retro-reflecting the beam back through the interferometric device on the third pass.

11. (Currently Amended) The apparatus of Claim 1, wherein the apparatus is configured such that line broadening due to divergency is less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

12. (Currently Amended) The apparatus of Claim 1, wherein the apparatus is configured such that line shift due to deviations of incident angles of the first and second passes is less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

13. (Currently Amended) The apparatus of Claim 1, wherein the apparatus is configured such that line broadening due to divergency and line shift due to deviations of incident angles of the first and second passes are in combination less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

14. (Currently Amended) An apparatus for measuring a spectral distribution of a narrow-band laser beam generated by a line-narrowed excimer laser or a molecular fluorine laser system, comprising:

[[an]] a tunable interferometric device disposed along an optical path of an output beam of the laser system, such that the beam traverses the tunable interferometric device on a first pass and is tuned over one of a plurality of free spectral ranges;

a retro-reflector disposed after the tunable interferometric device along said optical path for retro-reflecting the beam back through the tunable interferometric device on a second pass; and

a detector for ~~detecting~~ measuring an intensity of the beam tuned to said one of a plurality of free spectral ranges after the second pass through the interferometric device, and

wherein spectral information is determined ~~when the free spectral range of the interferometric device is tuned and the detector measures~~ by measuring the intensity of the beam at each of the [[a]] plurality of free spectral ranges.

15. (Original) The apparatus of Claim 14, wherein the detector includes a photodiode.

16. (Original) The apparatus of Claim 14, further comprising a housing within which the interferometric device is disposed, and wherein the free spectral range of the interferometric device is tuned by varying a pressure within the housing.

17. (Original) The apparatus of Claim 14, further comprising a light guidance cable, wherein the beam is directed towards the interferometric device through the light guidance cable.

18. (Original) The apparatus of Claim 17, wherein the light guidance cable includes a fiber optic.

19. (Original) The apparatus of Claim 17, further comprising a beam expander for expanding the beam after traversing the light guidance cable and before being incident upon the interferometric device.

20. (Original) The apparatus of Claim 17, further comprising a focusing lens, wherein the output beam is focused onto an input face of the light guidance cable by the lens.

21. (Original) The apparatus of Claim 17, wherein the beam makes a third interferometric pass prior to being incident upon the detector.

22. (Original) The apparatus of Claim 21, further comprising a second retro-reflector disposed after the first retro-reflector along the optical path of the beam, and after the beam has traversed the interferometric device on the second pass, the second retro-reflector for retro-reflecting the beam back through the interferometric device on the third pass.

23. (Original) The apparatus of Claim 14, wherein the beam makes a third interferometric pass prior to being incident upon the detector.

24. (Original) The apparatus of Claim 23, further comprising a second retro-reflector disposed after the first retro-reflector along the optical path of the beam, and after the beam has traversed the interferometric device on the second pass, the second retro-reflector for retro-reflecting the beam back through the interferometric device on the third pass.

25. (Currently Amended) The apparatus of Claim 14, wherein the apparatus is configured such that line broadening due to divergency is less than 0.1 times the passive bandwidth of <u>a</u> single pass <u>through</u> the interferometric device.

26. (Currently Amended) The apparatus of Claim 14, wherein the apparatus is configured such that line shift due to deviations of incident angles of the first and second passes is less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

27. (Currently Amended) The apparatus of Claim 14, wherein the apparatus is configured such that line broadening due to divergency and line shift due to deviations of incident angles of the first and second passes are in combination less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

28. (Currently Amended) An apparatus for measuring a spectral distribution of a narrow-band laser beam generated by a line-narrowed excimer laser or a molecular fluorine laser system, comprising:

an interferometric device disposed along an optical path of an output beam of the laser system such that the beam traverses the interferometric device on a first pass;

a retro-reflector disposed after the interferometric device along said optical path for retro-reflecting the beam back through the interferometric device on a second pass;

a detector for detecting an intensity of the beam after the second pass through the interferometric device; and

a light guidance cable for directing the beam towards the interferometric device; [[.]]

wherein the interferometric device is tunable such that beam traversing the interferometric device is tuned over one of a plurality of free spectral ranges of the interferometric device, and the spectral distribution is determined by examining each of the plurality of free spectral ranges.

29. (Original) The apparatus of Claim 28, wherein the light guidance cable includes a fiber optic.

30. (Original) The apparatus of Claim 28, further comprising a beam expander for expanding the beam after traversing the light guidance cable and before being incident upon the interferometric device.

31. (Original) The apparatus of Claim 28, further comprising a focusing lens, wherein the output beam is focused onto an input face of the light guidance cable by the lens.

32. (Currently Amended) An apparatus for measuring a spectral distribution of a narrow-band laser beam generated by a line-narrowed excimer laser or a molecular fluorine laser system, comprising:

[[an]] a pressure-tunable interferometric device disposed along an optical path of an output beam of the laser system such that the beam traverses the interferometric device on a first pass, the pressure-tunable interferometric device being tunable to any of a plurality of free spectral ranges;

a retro-reflector disposed after the interferometric device along said optical path for retro-reflecting the beam back through the interferometric device on a second pass;

a detector for detecting an intensity of the beam over one of said plurality of free spectral ranges after the second pass through the interferometric device, and

wherein the beam makes a third interferometric pass prior to being incident upon the detector, and the spectral distribution can be measured by detecting an intensity of the beam at each of said plurality of free spectral ranges.

33. (Original) The apparatus of Claim 32, further comprising a second retro-reflector disposed after the first retro-reflector along the optical path of the beam, and after the beam has traversed the interferometric device on the second pass, the second retro-reflector for retro-reflecting the beam back through the interferometric device on the third pass.

34. (Currently Amended) The apparatus of Claim 32, wherein the apparatus is configured such that line broadening due to divergency is less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

35. (Currently Amended) The apparatus of Claim 32, wherein the apparatus is configured such that line shift due to deviations of incident angles of the first and second passes is less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

36. (Currently Amended) The apparatus of Claim 32, wherein the apparatus is configured such that line broadening due to divergency and line shift due to deviations of incident angles of the first and second passes are in combination less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

37. (Original) The apparatus of Claim 32, further comprising a light guidance cable, wherein the beam is directed towards the interferometric device through the light guidance cable.

38. (Original) The apparatus of Claim 37, wherein the light guidance cable includes a fiber optic.

39. (Original) The apparatus of Claim 37, further comprising a beam expander for expanding the beam after traversing the light guidance cable and before being incident upon the interferometric device.

40. (Original) The apparatus of Claim 37, further comprising a focusing lens, wherein the output beam is focused onto an input face of the light guidance cable by the lens.

41. (Currently Amended) An apparatus for measuring a spectral distribution of a narrow-band laser beam generated by a line-narrowed excimer laser or a molecular fluorine laser system, comprising:

an interferometric device disposed along an optical path of an output beam of the laser system such that the beam traverses the interferometric device on a first pass;

a retro-reflector disposed after the interferometric device along said optical path for retro-reflecting the beam back through the interferometric device on a second pass; and

a detector for detecting an intensity of the beam after the second pass through the interferometric device, and

wherein spectral information is determined [[and]] by the detector ~~makes~~ making a plurality of measurements of the intensity of the beam, each measurement being made

when the interferometric device is tuned to a free spectral range of the interferometric device.

42. (Original) The apparatus of Claim 41, wherein the interferometric device includes an etalon.

43. (Original) The apparatus of Claim 41, wherein the interferometric device is tuned by adjusting the gas pressure between reflecting surfaces of the interferometric device.

44. (Original) The apparatus of Claim 43, wherein the plurality of measurements are made by the detector at a plurality of gas pressures between the reflecting surfaces of the interferometric device.

45. (Original) The apparatus of Claim 41, wherein the beam makes a third interferometric pass prior to being incident upon the detector.

46. (Original) The apparatus of Claim 45, further comprising a second retro-reflector disposed after the first retro-reflector along the optical path of the beam, and after the beam has traversed the interferometric device on the second pass, the second retro-reflector for retro-reflecting the beam back through the interferometric device on the third pass.

47. (Currently Amended) The apparatus of Claim 41, wherein the apparatus is configured such that line broadening due to divergency is less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

48. (Currently Amended) The apparatus of Claim 41, wherein the apparatus is configured such that line shift due to deviations of incident angles of the first and second passes is less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

49. (Currently Amended) The apparatus of Claim 41, wherein the apparatus is configured such that line broadening due to divergency and line shift due to deviations of

incident angles of the first and second passes are in combination less than 0.1 times the passive bandwidth of a single pass through the interferometric device.

REMARKS/ARGUMENTS

Claims 1-49 were pending in the present application. The present response does not add or cancel any claims, but amends claims 1, 11-14, 25-28, 32, 34-36, 41, and 47-49, leaving pending in the present application claims 1-49. Reconsideration of the pending claims is respectfully requested.

I. Objection to the Claims

Claims 11-13, 25-27, 34-36, and 47-49 are rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. These claims have been amended for purposes of clarity, and should have proper antecedent basis for each recited limitation. Applicants therefore respectfully request that the objection to the claims be withdrawn.

II. Rejection to the Claims under 35 U.S.C. §102

Claims 1, 2, 14, 15, 41, and 42 are rejected under 35 U.S.C. §102(e) as being anticipated by *Ershov* (US 6,243,170). Applicants' independent claims, including claims 1, 14, and 41, have been amended for purposes of clarity, and as amended require that the interferometric device be tunable such an x-ray beam traversing the interferometric device is tuned over one free spectral range of the interferometric device, and that spectral information can be determined by measuring the intensity of the beam at each of a plurality of free spectral ranges. *Ershov* does not disclose a tunable interferometric device, or measuring intensity at each of a plurality of free spectral ranges. *Ershov* instead discloses illuminating a non-tunable double-etalon configuration with "light scattered from the diffuser" in order to detect "a fringe pattern 49" consisting of "multiple peaks" in a single step (col. 3, lines 1-21). *Ershov* therefore cannot anticipate Applicants' independent claims, including claims 1, 14, and 41.

Further, the teachings of *Ershov* would not render Applicants' independent claims obvious. Using the configuration and approach of *Ershov*, the entire spectrum of a laser beam is viewed in a single instance. Simultaneous viewing of the entire spectrum, however, allows for the interference and superposition of fringes. The "theoretical values for two perfect etalons" using the *Ershov* approach is then limited to "0.09 (FWHM) and 0.25 (95% integral)," and "bandwidth resolutions in the range of 0.1 pm for FWHM and about 0.3 for the 95% integral are

obtainable with the FIG. 3 double pass etalon spectrometer" (col. 3, lines 31-39). In the inventions recited in Applicants' independent claims, an interferometric device such as an etalon can be pressure-tuned for each of a series of measurements, such that a beam traversing the etalon is tuned over one free spectral range for each measurement. The detector can then individually measure the intensity of the beam at each of several different free spectral ranges. For each spectral range, a single peak can be measured without interference from, or superposition of, other peaks or fringes. This stepped approach, whereby peaks can be examined individually instead of simultaneously as in *Ershov*, yields results that are superior to those of *Ershov*. Due in part to the greatly reduced amount of interference when viewing over a free spectral range, results on the order of 0.05 pm and 0.03 pm can be obtained (see application pages 8 and 9), which are less than even the *theoretical* minimums of *Ershov*. Therefore, not only is the invention of each independent claim neither taught nor suggested by *Ershov*, but the invention obtains superior results to those that could be obtained using the teachings of *Ershov*.

Also, there is no motivation in *Ershov* to use a tunable interferometric device. The system of Ershov is meant to be a "compact spectrometer" built "as part of a diagnostic set" that can be "used in the field during the microlithography process" (col. 2, lines 25-29). To this end, *Ershov* in each embodiment utilizes "light scattered from the diffuser" in order to detect "a fringe pattern 49" consisting of "multiple peaks" (col. 3, lines 1-21), thereby allowing the entire spectrum to be quickly and easily analyzed in a single step. A tuned interferometric device would not work in such a field-used diagnostic tool, as the spectrum of the laser could not be analyzed in a single step. The device as claimed by the Applicants requires multiple steps to analyze the spectrum, and there is no suggestion that such an approach would be efficient for "continuous monitoring capabilities" in order to simply keep the laser "operating within" manufacturing "specifications" (col. 1, lines 37-43). *Ershov* points out in the teachings that "high resolution" systems capable of providing "accurate spectral measurement" may not be "well-suited for production line microlithography use" (col. 2, lines 18-30). There is no suggestion that the higher precision of the Applicants' device would necessary for maintaining a beam within process specifications, or well-suited for constant monitoring in production use. Also, there is no suggestion that a stepped approach could be used for constant monitoring with any likelihood of success, as the entire spectrum would not be constantly monitored at any one time. This could allow the laser to go outside manufacturing specifications without immediate

detection. As *Ershov* does not teach or suggest the invention of each independent claim, and does not provide any motivation to use a tunable interferometric device or a stepped measurement procedure, the independent claims and associated dependent claims cannot be rendered obvious by *Ershov*. Applicants therefore respectfully request that the rejection with respect to claims 1, 2, 14, 15, 41, and 42 be withdrawn.

III. Rejection to the Claims under 35 U.S.C. §103

Claims 3-10, 17-24, 28-40, and 43-46 are rejected under 35 U.S.C. §103(a) as being obvious over *Ershov*. As discussed above, Applicants' independent claims contain limitations that are not rendered obvious by *Ershov*. Applicants' independent claims, and associated dependent claims, therefore cannot be rendered obvious by *Ershov*. Applicants therefore respectfully request that the rejection with respect to claims 3-10, 17-24, 28-40, and 43-46 be withdrawn.

IV. Amendment to the Claims

Unless otherwise specified, amendments to the claims are made for purposes of clarity, and are not intended to alter the scope of the claims or limit any equivalents thereof. The amendments are supported by the specification and do not add new matter to the specification.

V. Conclusion

In view of the above, it is respectfully submitted that the application is now in condition for allowance. Reconsideration of the pending claims and a notice of allowance is respectfully requested.

The Commissioner is hereby authorized to charge any deficiency in the fees filed, asserted to be filed, or which should have been filed herewith (or with any paper hereafter

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filed in this application by this firm) to our Deposit Account No. 50-1703, under Order No. TWI-13310. **A duplicate copy of the transmittal cover sheet attached to this Response to Office Action Mailed June 4, 2003, is provided herewith.**

Respectfully submitted,

STALLMAN & POLLOCK LLP

Dated: October 2, 2003

By: ____________________

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